APPENDIX A

CLEAN CLAIMS FOR 0275M-000260/DVB

1. An electronic control system for use in a riveting process, the system comprising:

an electronic control unit;

an electric motor connected to the electronic control unit;

a first sensor connected to the electronic control unit and the electric motor, the first sensor being operable to indicate at least one of: (a) torque of the electric motor, (b) speed of the electric motor, and (c) an electrical power characteristic of the electric motor; and

a second sensor connected to the electronic control unit, the second sensor operably detecting a riveting characteristic occurring during the riveting process, the riveting characteristic consisting essentially of at least one of: (a) riveting force, (b) rivet punch assembly location, (c) rivet size, and (d) workpiece thickness.

2. The system of Claim 1 further comprising a rivet and a riveting machine which includes the electric motor, the riveting machine operably moving the rivet.

3. The system of Claim 2 further comprising:

a rivet feeder having an actuator connected to the electronic control unit; and

a feed tube sensor connected to the electronic control unit;

wherein the electronic control unit operably controls feeding of the rivet by the feeder during the riveting process and the feed tube sensor sends a signal to the electronic control unit indicative of the presence of the rivet.

4. The system of Claim 1 further comprising a punch and a transmission, the transmission being operable to convert rotary motion of the electric motor to linear motion driving the punch.

5. The system of Claim 4 wherein the transmission includes a closed loop belt.

6. The system of Claim 1 wherein the riveting characteristic sensed by the second sensor is the riveting force.

7. The system of Claim 1 wherein the riveting characteristic sensed by the second sensor is the rivet punch assembly location.

8. The system of Claim 1 wherein the riveting characteristic sensed by the second sensor is a rivet size.

9. The system of Claim 1 wherein the riveting characteristic sensed by the second sensor is a workpiece thickness.

10. The system of Claim 1 wherein the second sensor is a load cell operably indicating a linearly moving member force.

11. The system of Claim 1 wherein the second sensor is a proximity switch.

12. A riveting electrical control system comprising:

(a) an electrical control unit;

(b) an electric motor connected to the electrical control unit;

(c) a transmission operably driven by energization of the electric motor;

(d) a riveting punch operably advanced by the transmission; and

(e) a sensor connected to the electrical control unit, the sensor being operable to sense riveting force.

13. The system of Claim 12 further comprising a rivet operably driven by the punch.

14. The system of Claim 13 further comprising:

a rivet feeder having an actuator connected to the electronic control unit; and

a feed tube sensor connected to the electronic control unit;

wherein the electronic control unit operably controls feeding of the rivet by the feeder during the riveting process and the feed tube sensor sends a signal to the electronic control unit indicative of the presence of the rivet.

15. The system of Claim 12 wherein the transmission operably converts rotary motion of the electric motor to linear motion for moving the punch.

16. The system of Claim 15 wherein the transmission includes a closed loop belt.

17. The system of Claim 12 wherein the characteristic changes at least in part due to varying rivet setting performance.

18. The system of Claim 12 further comprising a second sensor operably sensing an electrical power characteristic of the electric motor.

19. The system of Claim 12 further comprising a second sensor operably sensing a speed of the electric motor.

20. The system of Claim 12 further comprising a second sensor operably sensing a torque of the electric motor.

21. The system of Claim 12 wherein the electric control unit is a programmable computer.

22. A riveting electrical control system comprising:

(a) an electrical control unit;

(b) an electric motor connected to the electrical control unit;

(c) a transmission operably driven by energization of the electric motor, the transmission operably converting rotational movement of the electric motor to substantially linear movement;

(d) a riveting punch operably advanced in a substantially linear direction by the transmission;

(e) a self-piercing rivet operably driven by the punch as controlled by the electrical control unit; and

(f) a die operably diverging an end of the rivet without the rivet piercing completely through the exterior surface of a die-side workpiece adjacent the die;

the electric control unit operably controlling energization of the electric motor and operably determining if an undesired riveting condition is present.

23. The system of Claim 22 further comprising a sensor connected to the electrical control unit, the sensor being operable to sense a characteristic of the electric motor, wherein the characteristic changes at least in part due to varying rivet setting performance.

24. The system of Claim 23 wherein the characteristic is an electrical power characteristic of the electric motor.

25. The system of Claim 24 wherein the electrical power characteristic is electrical current.

26. The system of Claim 23 wherein the electrical control unit compares a signal from the sensor to previously stored data.

27. The system of Claim 22 wherein a rotational axis of the electric motor is offset from a centerline coaxial with an advancing direction of the punch.

28. The system of Claim 27 wherein the motor axis is substantially parallel to the punch centerline.

29. The system of Claim 22 wherein the electrical control unit includes a programmable microprocessor.

30. The system of Claim 22 wherein the electronic control unit automatically operably causes varying sized self piercing rivets to be operably driven by the punch.

31. The system of Claim 22 wherein the electrical control unit transmits an error signal if the undesired condition is present.

32. The system of Claim 22 wherein the electrical control unit stops the rivet process if the undesired condition is present.

33. The system of Claim 22 wherein the electrical control unit determines if a riveting characteristic is within a desired range.

34. A control system comprising:

(a) a programmable control unit;

(b) a riveting machine including an electric motor and a transmission operable to convert rotary motion of the electric motor to linear motion of a punch;

(c) a self piercing rivet operably set by the punch acting with a substantially relatively stationary die of the riveting machine when the control unit causes energization of the electric motor; and

(d) a feeder operable to transfer the rivet to the riveting machine.

35. The system of Claim 34 further comprising a sensor located adjacent the rivet machine, the control unit being operable to receive a signal generated by the sensor.

36. The system of Claim 35 wherein the control unit compares the signal generated by the sensor to previously stored data.

37. The system of Claim 35 wherein the sensor is attached to the rivet machine.

38. The system of Claim 35 wherein the sensor is operable to indicate a characteristic of the electric motor.

39. The system of Claim 34 wherein the control unit is operable to control actuation of the rivet feeder.

40. The system of Claim 34 further comprising an articulating robot, the riveting machine being attached to and positioned by the robot.

41. The system of Claim 34 wherein the control unit transmits an error signal if an undesired condition is present.

42. The system of Claim 34 wherein the electrical control unit determines if a riveting characteristic is within a desired range, the rivet being of a hollow and diverging type with a solid head.

43. A control system comprising:

(a) a programmable controller;

(b) a riveting machine including an electric motor and a transmission, the transmission being operable to convert rotary motion of the electric motor to substantially linear motion;

(c) a rivet operably moved by the riveting machine when the controller causes energization of the electric motor, the rivet being of a hollow and diverging type with a solid head; and

(d) a sensor operable to indicate power consumption of the electric motor, the controller operably receiving a signal generated by the sensor.

44. The system of Claim 43 wherein the controller compares the signal generated by the sensor to previously stored values.

45. The system of Claim 43 further comprising a rivet feeder connected to the riveting machine, the controller operably controlling actuation of the rivet feeder.

46. The system of Claim 43 further comprising an articulating robot, the riveting machine being attached to and positioned by the robot.

47. The system of Claim 43 wherein the transmission includes an endless belt.

48. A control system comprising:

(a) a programmable controller;

(b) a riveting machine including an electric motor and a transmission, the transmission being operable to convert rotary motion of the electric motor to linear motor, a section of the electric motor being rotatable about an axis offset from a centerline coaxial with an elongated dimension of the punch;

(c) a rivet operably moved by the riveting machine when the controller causes energization of the electric motor;

(d) a sensor operable to indicate a riveting force characteristic, the controller operably receiving a signal generated by the sensor;

(e) an articulating robot, the riveting machine being attached to and positioned by the robot; and

(f) a rivet feeder connected to the riveting machine, the controller operably controlling actuation of the rivet feeder.

49. The system of Claim 48 wherein the controller compares the signal generated by the sensor to previously stored data, and the rivet having a solid head and a diverging open end which does not completely penetrate a workpiece farthest from the head.

50. A riveting electrical control system comprising:

(a) an electrical control unit;

(b) an electric motor connected to the electrical control unit;

(c) a mechanical transmission operably converting rotational movement of the electric motor to substantially linear movement; and

(d) a rivet setting punch operably advanced by the transmission;

(e) the electrical control unit operably determining if a riveted joint is within a desired range.

51. The system of Claim 50 wherein the electrical control unit stops the rivet process if the undesired condition is present.

52. The system of Claim 50 wherein the electrical control unit transmits an error signal if the undesired condition is present.

53. The system of Claim 50 wherein the electrical control unit includes a programmable microprocessor which compares sensed data to other data, and the electrical control unit continuously compares actual workpiece thickness signals to previously stored workpiece thickness signals substantially during rivet setting.